Welcome

CROP DIVERSIFICATION IN MARATHWADA REGION OF MAHARASHTRA STATE :

An economic Analysis

INTRODUCTION

Diversification is an integral part of the process of structural transformation of an economy, diversification in agriculture can mean any of the three situations :

(1) A shift from less profitable crop (or enterprise) to more profitable crop (or enterprise)

(2) Using resources in diverse but complementary activities (Vyas,1996).

The first type can be viewed as a farmers response to relative price signals to adjust to the market conditions and The second type hints towards efficient allocation of resources.

Objectives

1) To examine cropping pattern changes in different districts of Marathwada region over a period of time

2) To study growth rates of area , production and productivity of major crops in different districts of Marathwada region

3) To study extent of crop diversification in different districts of Marathwada region

4) To identify determinants of crop diversification in different decadal periods.

METHODOLOGY

The study was confirmed to the Marathwada region of Maharashtra state. Therefore, the analysis for the present study was extended to two divisions of Marathwada i.e. Aurangabad and Latur and for Marathwada region as a whole. The districts selected for the present study were Aurangabad, Jalana , Beed , Latur , Osmanabad , Nanded , Parbhani , and Hingoli.

For the present study all the major food grain and non food grain crops of Marathwada region were selected.

Crops selected for the study

1) Cereals group - 1.Rice 2. Wheat
3.Jowar - Kharif and Rabi jowar
4.Bajara 5. Maize
6.Other cereals

2) Pulses group - 1.Tur 3.Mung
2.Gram 4.Other pulses

3) Oilseed groups - 1. Groundnut- Kharif and Summer groundnut
2. Soybean 3.Safflower 4. Sunflower

4) Commercial crops - 1. Cotton
2.Sugarcane

Data base

The present study was based on secondary data. Time series (secondary) data on the area, production and productivity of selected crops , total food production , crop-wise area under irrigation, season-wise crops grown , area under high yielding varieties of different crops, net cultivated area , area sown more than once, gross cropped area, annual rainfall, year-wise fertilizer consumption, source wise irrigation , average size of holding, and other infrastructural facilities like number of regulated markets ,no of tractors , agricultural advances, road length, number of working population , proportion of rural population , per capita income , state GDP and state income etc have been collected for the period 1980-81 to 2009-10. The data has pertained to a period of 30 years i.e. from 1980-81 to 2009-10, 2009-10 is the terminal period of the study as consolidated data was available upto 2009-10 only.

Analytical tools and techniques

Analysis of cropping pattern changes

Cropping pattern of various districts and divisions of Marathwada as well as Marathwada region as a whole have been studied in detail by tabular analysis for all the selected crops. Cropping pattern in terms of percentage share of individual crops in gross cropped area was worked out at points of time. The points at which analysis of cropping pattern has been worked out for the period i.e **Period I** – 1980-81 to 1984-85 , **Period II** – 1985-86 to 1989-90 , **Period III** – 1990-91 to 1994-95, **Period IV-** 1995-96 to 1999-2000 , **Period V** – 2000-01 to 2004-05, **Period VI** -2005-06 to 2009-2010 and for **Overall Period-** 1980-81 to 2009-2010.

Growth analysis

compound growth rates

- It was estimated with the following exponential model.

$$Y = a\, b^{x} e^{u}$$

$$\text{Log } Y = \log a + x \log b + u$$

$$\text{CDI} = \text{Antilog of } (\hat{\hat{b}}-1) \times 100$$

Where,

Y = The dependent variable (area/production/yield)

a & b = Parameters of exponential model

Quantification of crop diversification

Crop diversification index and cropping intensity are indicators for observing and quantifying cropping pattern changes.

Entropy index (EI)

The index has been computed by taking the sum of squares of area proportion of each crop in the total cropped area. It has been calculated as:

$$\text{Entropy index} = \sum_{i=1}^{N} Pi \log (1/Pi)$$

Where,

N = Total number of crops

Pi = Proportion of area under i^{th} crops to total cropped area.

The index would increase with the increase in diversification and it approaches zero when there is perfect concentration ,i.e., when Pi equals one the upper bound of index is log N.

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Modified Entropy Index (M.E.I.)

Modified Entropy Index is used to overcome the limitation of Entropy Index by using variable base of logarithm instead of fixed base of logarithm .It can be computed as :

$$M.E.I = -\sum_{i=1}^{N} (P_i . \log_N P_i^t)$$

The M.E.I, however ,is equal to EI/ logN. It is worth mentioning that the base of logarithm is shifted to 'N' number of crops. This index has a lower limit equal to zero when there is complete concentration , and it assumes upper limit of one in case of perfect dispersion , i.e. it is bounded by zero and one .

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Composite Entropy Index (C.E.I)

This index possesses all desirable properties of Modified Entropy index, and was used to compare diversification across situations having different and large number of activities since it gives due weight to the number of activities .

The formula of calculating C.E.I is given by :

$$C.E.I = - \left(\sum_{i=1}^{N} P_i \times \log_N P_i \right) * \{1 - (1/N)\} \quad \text{Or}$$

C.E.I=(Modified Entropy Index)*{1-(1/N)}

The C.E.I has two components , distribution and number of crops, or diversity .The value of composite Entropy Index increases with the decrease in concentration and rises with the number of crops/activities . Both the components of index are bounded by zero and one and thus the value of C.E.I ranges between zero and one.

Factors affecting on crop diversification

$$Y = a + b_1 X_1 + b_2 X_2 + \ldots\ldots\ldots + b_n X_n + U$$

The explanatory variables will be considered as :

X_1 = Per capita income (Rs / person),
X_2 = Percentage of urban population,
X_3 = Percentage of area under high yielding variety (HYV) of cereals,
X_4 = Percentage of gross irrigated area to gross cultivated area,
X_5 = Annual rainfall (mm),
X_6 = Average size of land holding (ha) ,
X_7 = Market density (number of markets per 1,000 ha of gross cropped area),
X_8 = Fertilizer use (Kg/ha),
X_9 = Road length (square km per 1,000 ha of gross cropped area),
X_{10} = Percentage of small and marginal land holders in total holdings,
X_{11} = Mechanization (number of tractors per 1,000 ha of gross cropped area), and
U = Error term.

Result and Discussion

Table 1 . Change in cropping pattern in Marathwada region during 1980-81 to 2010-11
(Area in "00" hectares)

Marathwada Region														
	Period I	%	Period II	%	Period III	%	Period IV	%	Period V	%	Period VI	%	overall	%
Rice	1093	2.19	1036	1.89	1044	1.88	930	1.59	866	1.39	458	0.67	905	1.55
Kh.jawar	10228	20.47	9987	18.23	9584	17.22	8107	13.84	7052	11.31	5321	7.77	8380	14.37
R.jawar	10541	21.09	10961	20.00	10048	18.06	10153	17.34	10997	17.64	10758	15.71	10576	18.14
Bajara	3500	7.00	4212	7.69	4665	8.38	4575	7.81	4430	7.11	3658	5.34	4173	7.16
wheat	2874	5.75	2033	3.71	1976	3.55	2576	4.40	2413	3.87	3035	4.43	2485	4.26
Maize	_	_	_	_	_	_	625	1.07	1639	2.63	2086	3.05	725	1.24
Oth.cereals	480	0.96	531	0.97	773	1.39	1014	1.73	1776	2.85	2398	3.50	1162	1.99
Tur	2820	5.64	3379	6.17	4043	7.27	4096	7.00	4197	6.73	4429	6.47	3827	6.56
Gram	1766	3.53	1868	3.41	1857	3.34	2331	3.98	2644	4.24	3785	5.53	2375	4.07
Mung	_	_	_	_	_	_	1413	2.41	2651	4.25	1891	2.76	992	1.70
oth.pulses	4680	9.36	5741	10.48	5356	9.63	5070	8.66	5771	9.26	4882	7.13	5250	9.00
Kh.gn	1016	2.03	974	1.78	848	1.52	624	1.07	432	0.69	311	0.45	701	1.20
Summ Gn	201	0.40	563	1.03	523	0.94	273	0.47	194	0.31	238	0.35	332	0.57
Safflower	2724	5.45	3330	6.08	2576	4.63	2127	3.63	1932	3.10	1783	2.60	2412	4.14
Soybean	_	_	12	0.02	123	0.22	268	0.46	2462	3.95	6965	10.17	1638	2.81
Sunflower	860	1.72	2595	4.74	3493	6.28	3019	5.16	2184	3.50	2048	2.99	2367	4.06
Sugar cane	605	1.21	581	1.06	1079	1.94	1122	1.92	1341	2.15	2077	3.03	1134	1.95
Cotton	6586	13.18	6994	12.76	7660	13.77	10238	17.48	9372	15.03	12361	18.05	8868	15.21
GCA	49972	100	54797	100	55650	100	58560	100	62353	100	68484	100	58303	100

Note :- (Period I – 1980-81 to 1984-85 , Period II – 1985-86 to 1989-90 , Period III – 1990-91 to 1994-95
Period IV- 1995-96 to 1999-2000 , Period V – 2000-01 to 2004-05, Period VI -2005-06 to 2009-2010
Overall Period- 1980-81 to 2009-2010)

Change in cropping pattern in Marathwada region during 1980-81 to 2010-11
(Area in "00" hectares)

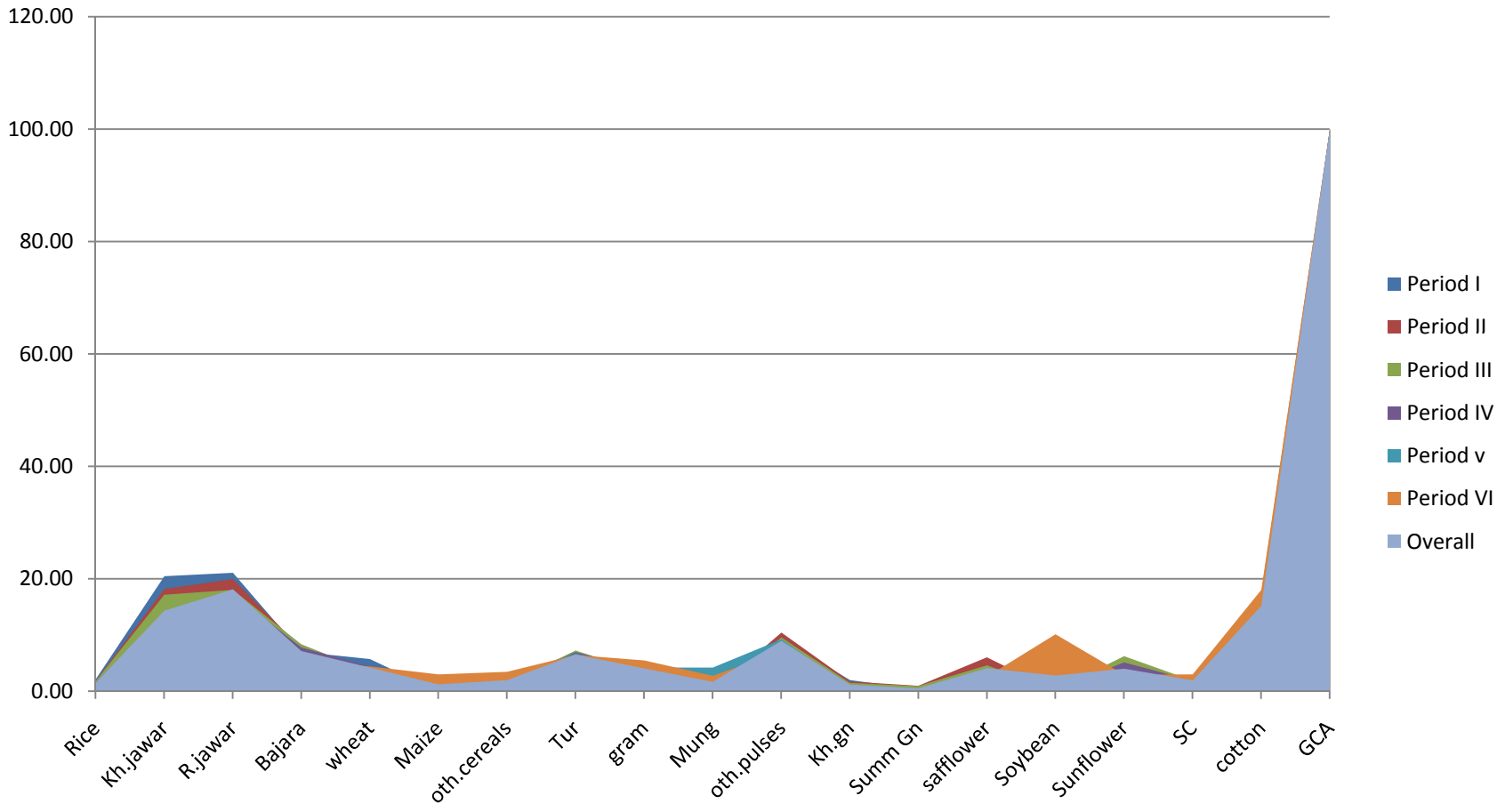

Table.2 Compound growth rates of area , production and productivity of major crops in Marathwada region

Table.10 Compound growth rates of Area, Production and Productivity of Major crops in Marathwada Region												
	Area				Production				Productivity			
	I	II	III	Overall	I	II	III	Overall	I	II	III	Overall
Rice	-0.79	-2.26	-14.73**	-3.25*	-7.56**	-0.33	-17.30**	-6.08**	-4.34**	-3.03*	-0.90	-2.49
SE(b')	0.004	0.002	0.013	0.003	0.021	0.016	0.014	0.004	0.017	0.017	0.010	0.003
	NS	NS				NS					NS	NS
K. Jowar	-0.56	-3.09*	-5.86**	-2.58*	-2.25	-0.72	-9.35**	-1.43	-1.32	2.01	-4.88**	0.85
SE(b')	0.002	0.002	0.003	0.001	0.019	0.016	0.008	0.003	0.019	0.015	0.007	0.003
	NS				NS	NS		NS	NS	NS		NS
R. Jowar	0.64	0.84	-0.41	0.10	3.25*	3.00*	5.06**	2.21*	5.11**	0.90	4.09**	2.74*
SE(b')	0.003	0.008	0.002	0.001	0.013	0.016	0.010	0.002	0.012	0.011	0.008	0.002
	NS	NS	NS	NS						NS		
Bajara	3.72**	-0.91	-4.39**	0.13	0.71	3.53**	-1.76	3.24**	1.78	2.32*	0.55	1.82
SE(b')	0.002	0.003	0.004	0.001	0.012	0.016	0.010	0.003	0.014	0.016	0.007	0.003
		NS		NS	NS		NS		NS		NS	NS
wheat	-4.92**	5.55**	2.76*	0.64	-3.09*	6.21**	4.83**	3.10**	4.62**	7.90**	2.66*	2.46*
SE(b')	0.009	0.011	0.006	0.002	0.018	0.017	0.011	0.003	0.011	0.019	0.007	0.003
				Ns								
Maize	_	484.55**	5.13**	103.10**	_	514.89**	12.25**	110.15**	_	680.90**	2.74*	115.11**
SE(b')	_	0.204	0.002	0.034	_	0.209	0.011	0.035	_	0.241	0.007	0.038
Oth.cereal	1.06	9.96**	5.84**	0.03	3.03**	13.86**	4.74**	0.05	5.28**	-0.06	-0.70	0.01
SE(b')	0.005	0.012	0.004	0.897	0.016	0.023	0.011	0.866	0.015	0.009	0.008	0.398
	NS			NS				NS		NS	NS	NS
Tur	3.75**	0.10	0.78	1.68	5.62**	7.43**	7.19**	3.56**	2.36*	8.29**	6.86**	2.05
SE(b')	0.003	0.002	0.002	0.001	0.013	0.031	0.009	0.004	0.020	0.028	0.008	0.004
		NS	NS	NS								NS

(Note :- *, Significant at 5 Per cent and 1 Per cent level respectively , NS- Non Significant)**

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Gram	1.40	5.41**	6.71**	3.01*	0.94	5.65**	12.43**	3.96**	7.14**	-0.13	5.99**	2.74*
SE(b')	0.005	0.008	0.003	0.001	0.025	0.020	0.008	0.004	0.015	0.014	0.006	0.002
	NS				NS					NS		
Mung	_	548.01**	-6.25**	104.70**	_	456.34**	-7.57**	93.44**	_	516.02**	-1.00	105.50**
SE(b')	_	0.216	0.007	0.036	_	0.195	0.022	0.033	_	0.210	0.020	0.035
											NS	
Oth.pulses	5.68**	-0.13	-3.12*	0.35	7.04**	0.39	2.80*	2.12	9.14**	0.05	3.54**	2.21*
SE(b')	0.016	0.003	0.002	0.002	0.007	0.020	0.014	0.003	0.013	0.018	0.012	0.003
		NS		NS		NS		NS		NS		
Kh.Gn	-0.96	-6.41**	-7.07**	-4.92**	-0.88	-4.04**	-2.45	-4.11**	3.47**	1.15	4.10**	0.51
SE(b')	0.003	0.006	0.005	0.001	0.019	0.018	0.012	0.003	0.019	0.016	0.008	0.003
	NS				NS		NS			NS		NS
Summ Gn	23.42**	-10.15**	-5.54**	-0.87	16.55**	-11.02**	-5.58**	-1.13	1.42	-3.94**	-0.87	-1.62
SE(b')	0.041	0.018	0.022	0.007	0.057	0.019	0.023	0.008	0.006	0.010	0.006	0.001
				NS				NS	NS		NS	NS
safflower	3.58**	-3.04*	-2.46	-2.21	4.54**	-3.35**	2.05	-2.29	4.69**	-1.44	4.81**	0.13
SE(b')	0.005	0.011	0.005	0.002	0.013	0.034	0.010	0.004	0.019	0.028	0.009	0.004
			NS	NS			NS	NS		NS		NS
Soybean	138.27**	40.47**	32.29**	89.01**	134.29**	102.93**	-6.65**	95.66**	219.08**	10.27**	-4.06**	86.36**
SE(b')	0.168	0.037	0.020	0.024	0.151	0.071	0.012	0.028	0.233	0.018	0.012	0.041
sunflower	25.66**	-3.46**	-3.21*	2.45*	25.13**	0.61	-0.61	3.95**	6.54**	9.37**	8.20**	-0.71
SE(b')	0.019	0.011	0.009	0.005	0.023	0.016	0.012	0.006	0.013	0.011	0.039	0.005
Sugarcane	0.71	1.53	5.16**	4.84**	12.25**	1.82	7.26**	6.13**	-0.74	21.61**	-2.03	14.41**
SE(b')	0.012	0.012	0.021	0.003	0.034	0.014	0.024	0.005	0.006	0.044	0.017	0.008
	NS	NS				NS			NS		NS	
Cotton	0.92	5.05**	5.06**	2.47*	3.62**	9.21**	18.01**	6.33**	4.96**	10.33**	13.59**	8.71**
SE(b')	0.002	0.003	0.003	0.001	0.021	0.013	0.010	0.003	0.017	0.015	0.010	0.003

(Note :- *, Significant at 5 Per cent and 1 Per cent level respectively , NS- Non Significant)**

Table 3. Measurement of crop diversification :-Decadal Diversification indices for various districts of Marathwada region as a whole with its Divisions

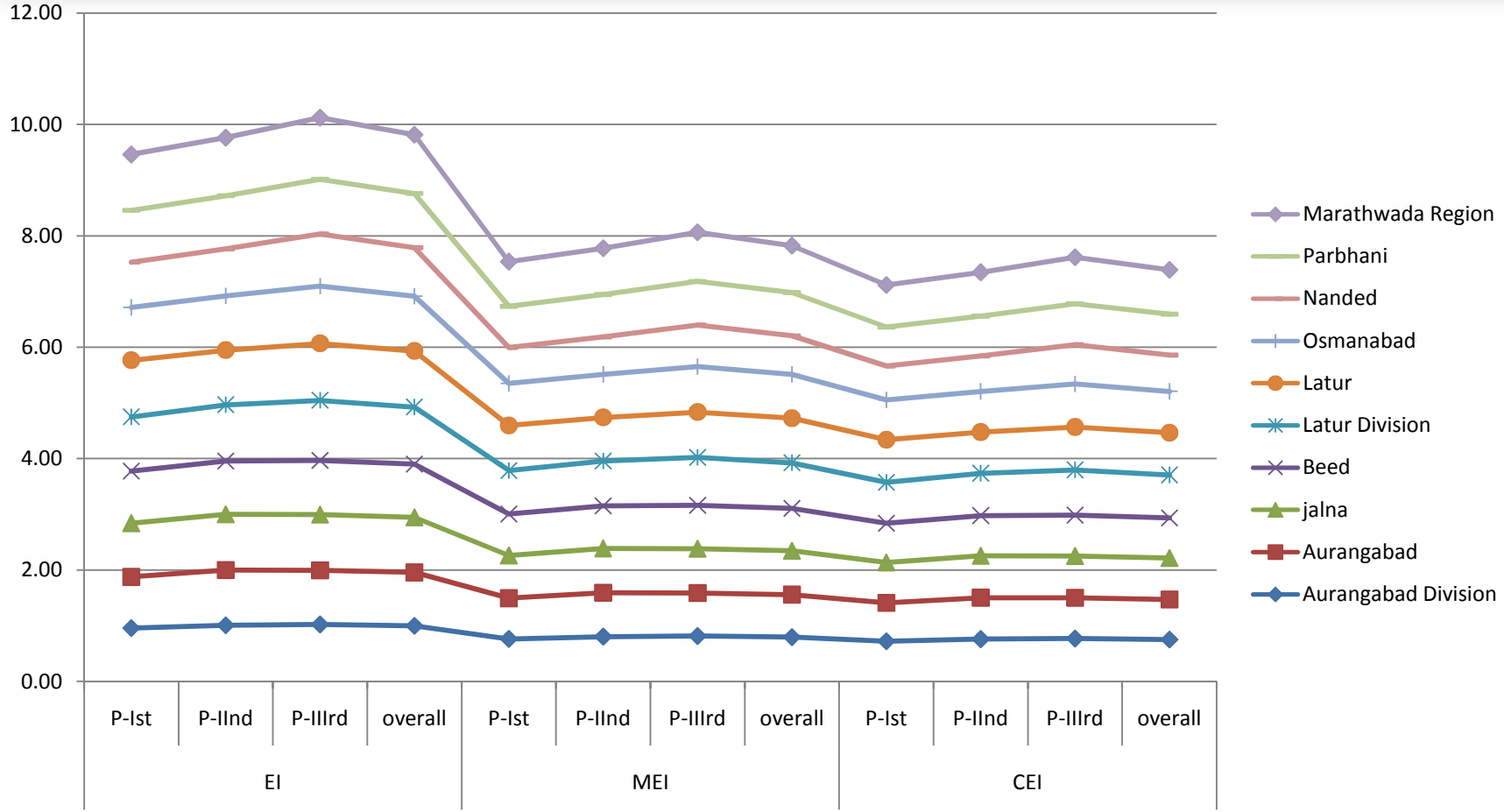
Index	Period	Aurangabad Division	Aurangabad	jalna	Beed	Latur Division	Latur	Osmanabad	Nanded	Parbhani	Marathwada Region
EI	P-Ist	0.96	0.92	0.97	0.93	0.97	1.02	0.95	0.81	0.93	1.00
	P-IInd	1.01	0.99	1.00	0.96	1.01	0.98	0.97	0.85	0.95	1.04
	P-IIIrd	1.02	0.97	1.00	0.97	1.08	1.02	1.03	0.94	0.98	1.11
	overall	1.00	0.96	0.99	0.96	1.02	1.01	0.99	0.87	0.98	1.05
MEI	P-Ist	0.76	0.73	0.77	0.74	0.78	0.81	0.76	0.64	0.74	0.80
	P-IInd	0.80	0.79	0.80	0.76	0.80	0.78	0.77	0.67	0.76	0.83
	P-IIIrd	0.81	0.77	0.80	0.78	0.86	0.81	0.82	0.75	0.78	0.88
	overall	0.79	0.77	0.79	0.76	0.82	0.80	0.79	0.69	0.78	0.84
CEI	P-Ist	0.72	0.69	0.73	0.70	0.73	0.76	0.72	0.61	0.70	0.75
	P-IInd	0.76	0.75	0.75	0.72	0.76	0.74	0.73	0.64	0.72	0.78
	P-IIIrd	0.77	0.73	0.75	0.73	0.81	0.77	0.77	0.70	0.74	0.83
	overall	0.75	0.72	0.74	0.72	0.77	0.76	0.74	0.65	0.73	0.79

Note : 1. EI-Entropy Index, MEI-Modified Entropy Index, CEI- Composite Entropy Index

2. Period I- 1980-81 to 1989-90 , Period II – 1990-91 to 1999-2000,Period III-2000-01 to 2009-10

3. Overall period- 1980-81 to 2009-10

Measurement of crop diversification :- Decadal Diversification indices for various districts of Marathwada region as a whole with its Divisions



Note : 1. EI-Entropy Index, MEI-Modified Entropy Index, CEI- Composite Entropy Index

2. Period I- 1980-81 to 1989-90 , Period II – 1990-91 to 1999-2000,Period III-2000-01 to 2009-10

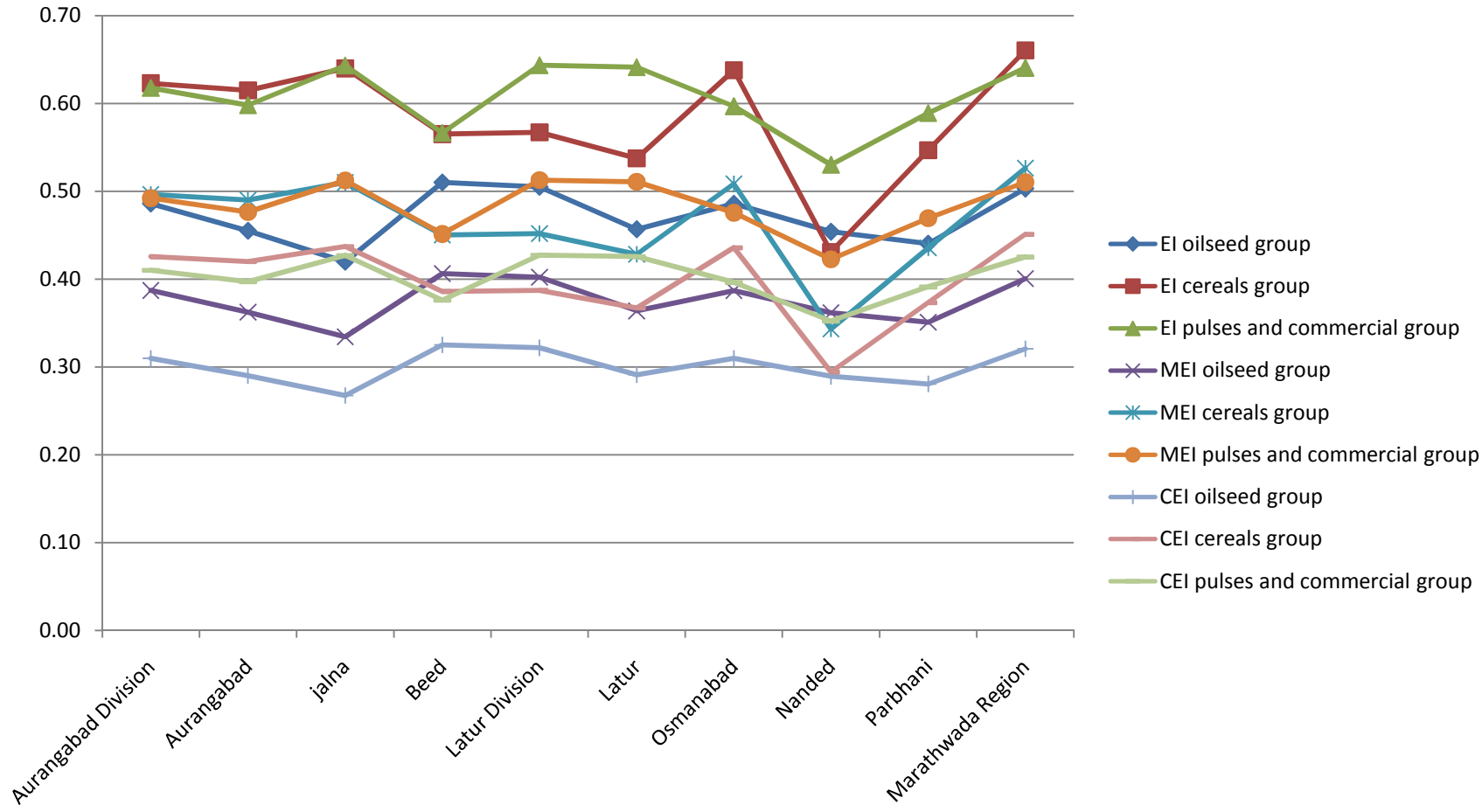
3. Overall period- 1980-81 to 2009-10

Table 23. Measurement of crop diversification :- Crops group wise Diversification indices for various districts of Marathwada region as a whole with its Divisions

Index	Crop group	Aurangabad Division	Aurangabad	jalna	Beed	Latur Division	Latur	Osmanabad	Nanded	Parbhani	Marathwada Region
EI	oilseed group	0.49	0.46	0.42	0.51	0.50	0.46	0.49	0.45	0.44	0.50
	cereals group	0.62	0.62	0.64	0.57	0.57	0.54	0.64	0.43	0.55	0.66
	pulses and commercial group	0.62	0.60	0.64	0.57	0.64	0.64	0.60	0.53	0.59	0.64
MEI	oilseed group	0.39	0.36	0.33	0.41	0.40	0.36	0.39	0.36	0.35	0.40
	cereals group	0.50	0.49	0.51	0.45	0.45	0.43	0.51	0.34	0.44	0.53
	pulses and commercial group	0.49	0.48	0.51	0.45	0.51	0.51	0.48	0.42	0.47	0.51
CEI	oilseed group	0.31	0.29	0.27	0.33	0.32	0.29	0.31	0.29	0.28	0.32
	cereals group	0.43	0.42	0.44	0.39	0.39	0.37	0.44	0.29	0.37	0.45
	pulses and commercial group	0.41	0.40	0.43	0.38	0.43	0.43	0.40	0.35	0.39	0.43

Note : EI-Entropy Index, MEI-Modified Entropy Index, CEI- Composite Entropy Index

Measurement of crop diversification :- Crops group wise Diversification indices for various districts of Marathwada region as a whole with its Divisions



Note : EI-Entropy Index, MEI-Modified Entropy Index, CEI- Composite Entropy Index

Table 4. Estimated regression function for the determinants of crop diversification for Overall crops

Table No. 4 Estimated regression function for the determinants of crop diversification for overall crops

	Aurangabad Division			Latur Division			Marathwada region		
	Coefficients	Standard Error	t Stat	Coefficients	Standard Error	t Stat	Coefficients	Standard Error	t Stat
Constant	0.842407	0.188571	4.467309	0.924175	0.174822	5.286385	1.012290	0.191849	5.276502
X_1	0.000092	0.007363	0.012558	-0.012775	0.006589	-1.938850	-0.007698	0.005182	-1.485676
X_2	-0.012189	0.022448	-0.542977	-0.011788	0.010197	-1.156023	-0.009738	0.011650	-0.835892
X_3	-0.000411	0.001668	-0.246359	-0.002584	0.001363	-1.895288	-0.001692	0.001875	-0.902398
X_4	-0.000221	0.001228	-0.180193	0.000984	0.000430**	2.287402	0.000468	0.000452	1.036978
X_5	-0.003992	0.003185	-1.253203	-0.002148	0.002085	-1.030445	-0.006372	0.002339	-2.723828
X_6	0.000755	0.000635	1.189359	0.000073	0.000318	0.228766	0.000481	0.000311	1.548870
X_7	0.000032	0.000048	0.672345	0.000064	0.000032**	2.013599	0.000026	0.000025	1.030208
X_8	0.006933	0.016261	0.426392	0.001863	0.009185	0.202834	0.021480	0.011629**	1.847177
X_9	-0.000042	0.000811	-0.052157	0.001396	0.000933*	1.496942	0.000562	0.000758	0.741297
X_{10}	0.000002	0.000002	1.256313	0.000002	0.000002	0.862908	0.000003	0.000002*	1.843440
X_{11}	-0.019273	0.007467	-2.581222	0.001179	0.009131	0.129164	-0.021283	0.007090	-3.001829
	R Square	**0.78**		**0.91**			**0.95**		
	F	**6.35**		**18.44****			**35.96****		

Conclusions

1) In Marathwada region gross cropped area increased from 49.97 lakh hectares to 68.48 lakh hectares during the period of thirty years i.e net increase in the area was 18.51 lakh hectares .

2) Area under cereal crops and mung decreased during last thirty years period. That area diverted to soybean and maize crop while area under rabi jawar diverted to gram.

3) Soybean is emerging as one of the major crop of Marathwada region which occupied 6.96 lakh hectares out of 68.48 lakh hectares gross cropped area. Area increased by 10.17 percent to gross cropped area during study period.

4) Latur division diversified more than that of Aurangabad division which showed continuously increased trend of Entropy , Modified Entropy and Composite Entropy index.

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5) Overall Latur district diversified more and Nanded district diversified less in Marathwada region .Aurangabad and Beed districts diversified somewhat at equal level.

6) About cereals group, Jalana and Osmanabad equally diversified where low level of diversification has been found in Nanded district.

7) In case of cereals group ,mechanization showed significant impact on crop diversification in Aurangabad district where fertilizer use was significantly affect on crop diversification in Latur district.In the case of oilseed group ,percentage of small and marginal land holders in total holding showed positively significant impact on oilseed group in Aurangabad district where average size of holding showed positive significant impact on crop diversification in Latur division.

Policy implications

The following implications are bought out from the important findings of the present study.

- It is revealed that cotton , kharif jawar , rabi jawar , soybean, tur and gram are major crops of Marathwada and therefore thrust should be given for the growth of these crops.
- Soybean appeared to be one of the important emerging crop in the cropping plan and hence the farmers should be encouraged to grow this crop by extending incentives in the form of quality seeds ,credit facility ,technical knowledge ,assured price and processing facilities in network.
- Crop diversification index showed significant possible indices indicating higher degree of diversification in Latur division while low diversification in Aurangabad division .This should be noted while deciding the policy on cropping plan in these regions

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Thank You